REMR TECHNICAL NOTE CS-ES-2.6

VIDEO SYSTEMS FOR UNDERWATER INSPECTION OF STRUCTURES

PURPOSE: To provide information on the use of underwater video systems for maintenance inspection of underwater structures or to monitor suspected problem areas of underwater structures.

Note: Reference to underwater video systems includes manned and unmanned Remote Operated Vehicles (ROV) and nonremote underwater video cameras, including accessory equipment.

APPLICATION: Underwater video systems can be used as an alternative method or as a supplement to traditional diver systems for inspection of underwater structures, particularly in areas of suspected risk to divers. Areas of high turbidity, adverse current and tidal conditions, and enclosed environments (such as intake shafts and pipelines) are examples of conditions that may justify employing ROV underwater video systems as an alternative to jeopardizing diver safety.

Other types of underwater video systems can be carried by the divers to provide photographs and to record the inspection dive.

ADVANTAGES: Unmanned underwater video systems allow inspection of underwater structures at greater depths and for longer time durations than do conventional diver systems. In addition, underwater video systems can perform repeated inspection dives at greater depths without sacrificing the quality of each inspection dive. Conventional diver systems beyond 150 to 200 ft have short time durations at greater depths and become increasingly limited on repeated dives at these depths within given time periods.

Underwater video systems can penetrate turbid waters to allow visible inspections where the human eye cannot see. Another advantage of underwater video systems is that visual recordings of the inspection report can be permanently stored for future reference, analysis, and review, thus enhancing the overall inspection records.

In general, underwater video systems are less expensive than conventional diver systems. Increases in savings are realized with increased usage of the underwater video system.

LIMITATIONS: Remotely operated underwater video systems (both manned and unmanned) that function independently of divers do not possess the maneuverability offered by conventional divers. Therefore, care should be exercised when an ROV is directed into areas of restricted space relative to the size of the ROV. Carelessness in such a situation could result in the ROV's becoming entangled or even possibly lost. Even though some ROVs include an extension

arm-type attachment for grasping some items, the ability to manipulate these items is usually restricted.

When detection of a suspected problem area requires a sense of feel (that is, suction), underwater video systems are usually not capable of accomplishing such a task. Larger and more complex underwater video systems demand extensive support (such as generator, placement and retrieval equipment), regardless of operating depth, whereas traditional diver systems require very little support in shallow depths.

PERSONNEL REQUIREMENTS: The personnel demands and associated skills required to operate underwater video systems, depending on the type of system selected, may include the following:

a. ROV control operator.

b. Instrumentation operators for display monitors, recording consoles, etc.

c. Equipment operator (that is, crane) to insert and retrieve ROVs at the water surface.

d. Interpreters to translate and analyze inspection recordings.

e. Qualified divers available to assist, if needed, with cables, initial placement, etc.

f. Support personnel to assist in handling ROV, instrumentation components, and accessory equipment.

Some manufacturers offer workshops (usually about 5 days) to train personnel in the proper operation and maintenance of their respective underwater video system. Nearly all manufacturers employ sales or service representatives available on call to demonstrate proper operation and maintenance of the underwater video system selected.

For very simple underwater video systems composed of the camera and perhaps one or two additional accessories, the manufacturer's instructions included with the unit are usually sufficient for one to understand operational procedures.

EQUIPMENT DESCRIPTION: Underwater video equipment used in inspection of underwater structures is commercially available in numerous varieties. Underwater video units range in sizes from small, compact, and lightweight to large and very heavy units. ROV-type underwater video equipment is basically composed of the video unit (housed in waterproof casing), a power source such as a generator or battery (units relying on generators as a power source have connecting cables), vehicle controllers (commonly referred to as "joysticks"), and a display monitor. In addition, a wide assortment of optional equipment is available to increase the unit's efficiency. Included as optional equipment are wide-angle lens, lighting components, optional instrumentation to provide various analyses, and attachments with grasping capabilities to extricate certain items of debris.

Nonremote video equipment used concurrently with diver teams may consist of only the underwater video unit charged by a battery pack. Similar optional equipment available for ROVs, mentioned above, is also available for nonremote underwater video units.

Below is a brief look at some specific underwater video systems:

a. MOS VR-F, Diver Camera System (Figure 1)
Marine Optical Systems

Features:
1. Dimensions (L × W × H)--7.9 × 10.2 × 15.8 in.
2. Weight (air)--25.3 lb
3. Depth rating--300 ft
4. Power required--9.6 v DC
5. JVC GR-C1 Video Camera/Cassette Recorder

Options:
6. Optical viewfinder
7. 80-w halogen underwater light
8. Wide-angle adapter kit
9. Support arm and battery charger for optional lights

b. RASCL, ROV (Figure 2)
Sea-Con Services Ltd.

Features:
1. Dimensions (L × W × H)--50 × 18 × 21 in.
2. Weight (air)--120 lb
3. Depth rating--1,200 ft
4. Power required--120 v AC
5. Panasonic TV camera in acrylic dome

Options:
6. Still camera
7. Sonar
8. Vehicle tracking (Honeywell RS7)
9. Xenon-flasher
10. Color video camera

c. Phantom 500, ROV (Figure 3)
Deep Ocean Engineering

Features:
1. Dimensions (L × W × H)--58 × 22 × 20 in.
2. Weight (air)--58 lb
3. Depth rating--500 ft
4. Power required--110 v AC
5. Stainless steel crash frame
6. Low-light color camera

Options:
1. Video tape recorder
2. Additional cameras
3. Lateral maneuverability
4. Sonar

d. Minicamera, Diver/ROV Systems (Figure 4)
Benthos Undersea Systems Technology

Features:
1. Weight (water)--0.4 lb
2. Depth rating--600 ft
3. Power required--9 v DC
4. Attachable to diver helmet or ROV
5. High-resolution photography

COSTS: As mentioned earlier, underwater video systems are generally less expensive for inspection of underwater structures than are traditional diver systems. Just as the variety of underwater video systems spans a broad range, the cost of these units also varies across the spectrum. One small underwater camera, Model #VM 6000P manufactured by Jay-Mar Engineering, lists for $1,595.00, while Sea-Con manufactures the RASCL, ROV, which lists for $50,000.00. A judgment should therefore be made to assure that the unit selected and the associated costs do not exceed what is required to accomplish the inspection task.

A complete price list including optional equipment can be obtained by contacting the various manufacturers. The prices given below are only a small sample of the cost involved in securing an underwater video system.

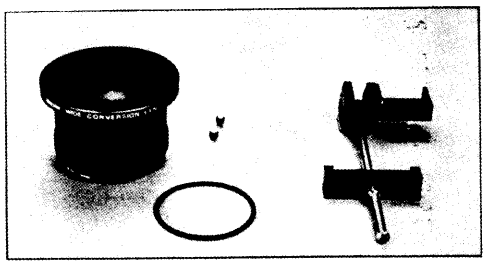
a. TC-125 Miniature Underwater Television Camera
Hydro Products

- L7-8 diver light
- Surface unit (Model SC-303-HW) includes 9-in. monitor, power supply, light power source, and underwater telephone module with headset and mike
- Recorder (Sony AV 3650)
- Communication mask (Model KMB-10)
- Cable (C-105 Television System Cable), 300 ft
- Carrying case

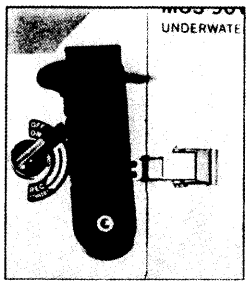
Total Cost: Approximately $20,000.00

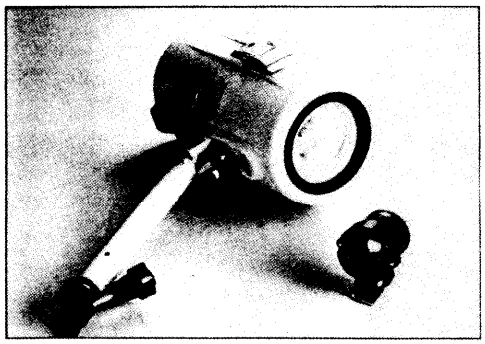
b. DVC-500 CCD Video Camera
Deep Sea Power and Light Company

- Base unit (8-mm lens), $2,650.00
- Seabatteries (12 v, 65AH), $895.00
- Minilights (bulbs), $10.00-$30.00
- Microlights (flat or dome), $145.00



Standard accessories: Wide angle lens adapter (for increased field of view); bracket repositions electronic viewfinder to rear viewport.





Large format optical viewfinder

Figure 1. MOS VR-F, Diver Camera System

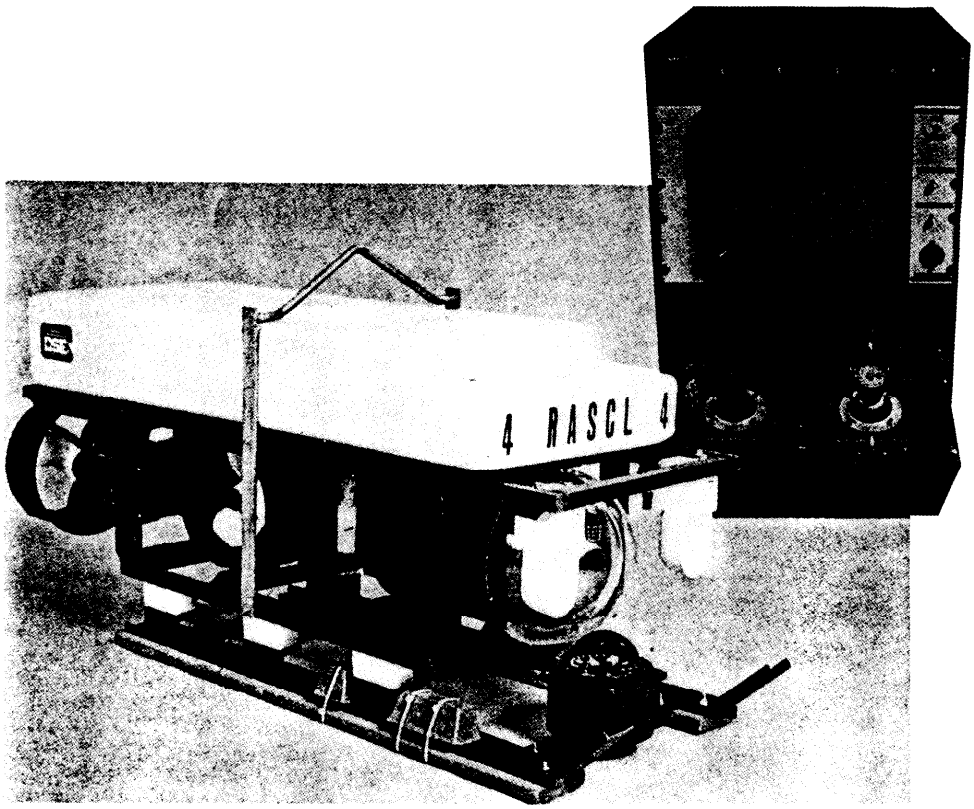


Figure 2. RASCL, ROV

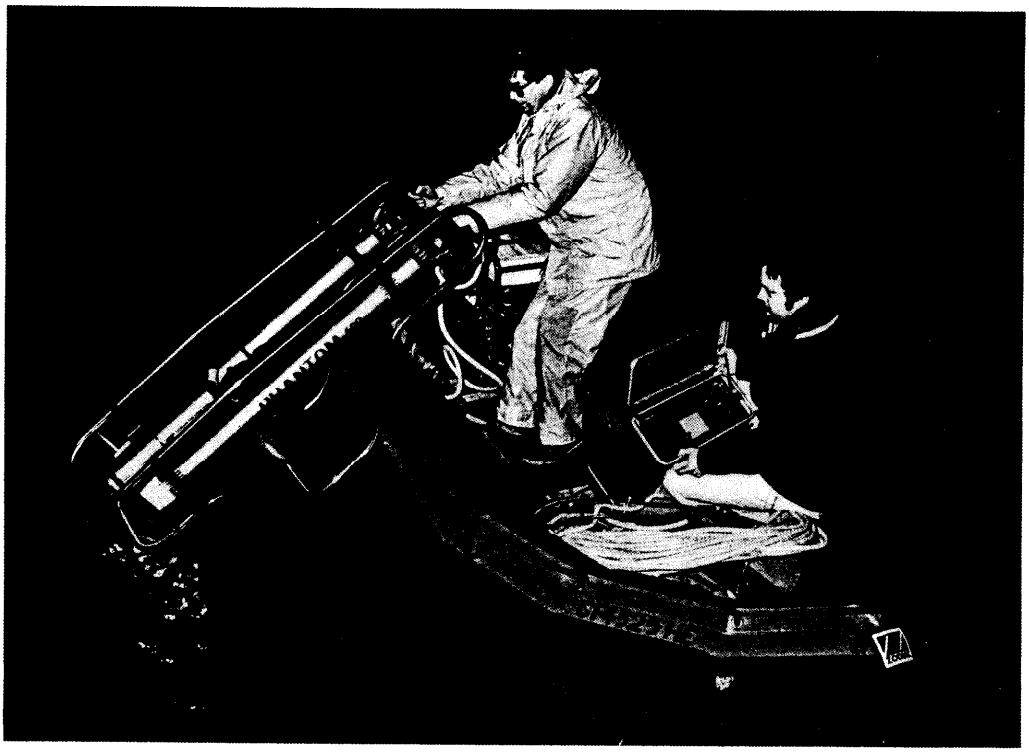


Figure 3. Phantom 500, ROV

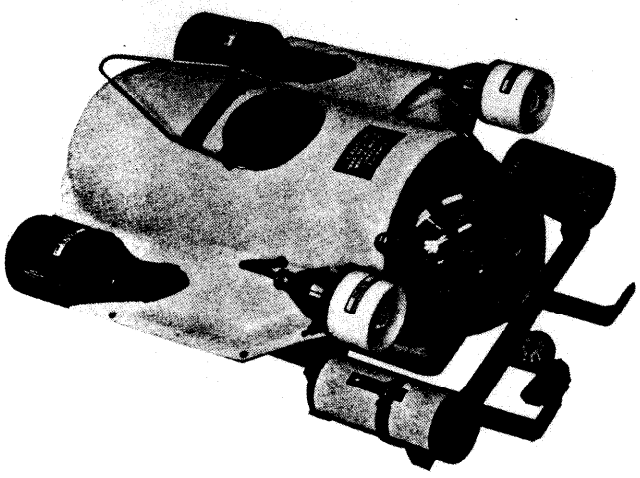


Figure 4. Model 3782 Minicamera

c. Phantom 500, ROV
Deep Ocean Engineering

- 5-in. color monitor
- Low-light color camera
- 90-deg wide-angle lens
- Thrust booster

Total Cost: $28,400.00

MANUFACTURERS:

a. Jay-Mar Engineering Services
1910 Milan Place
San Pedro, CA 90732
213-833-0577

b. Deep Sea Power and Light Company
4968 Diane Place
San Diego, CA 92117
619-576-1261

c. Sub-Sea Systems Incorporated
753 West Washington Avenue
Escondido, CA 92025
619-747-4223

d. Marine Optical Systems Incorporated
25 Sylvan Road South
Westport, CT 06880
203-226-4880

e. Benthos Undersea Systems Technology
North Falmouth, MA 02556
617-563-5917, 540-5500

f. Deep Ocean Engineering
1431 Doolittle Drive
San Leandro, CA 94577
415-562-9300

ENVIRONMENTAL CONSIDERATIONS:

None noted.